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BUILDING ENERGY SIMULATION

FOR USERS OF ENERGYPLUS, SPARK, DOE-2, BLAST, GENOPT, BUILDING DESIGN ADVISOR, ENERGY-10 AND THEIR DERIVATIVES

USERNEWS

What's New ?

VisualSPARK 1.0 Release .....

VisualSPARK 1.0 is now available! See the article on p. 10 for details.
To purchase VisualSPARK, go to

http://SimulationResearch.lbl.gov

EnergyPlus Beta 4 .....

The fourth planned beta test version of EnergyPlus was released in October. To get a no-cost license for Beta 4 go to

www.gard.com/eplustest.htm

If you already have a license for testing previous versions of EnergyPlus, you don't need a new license for Beta 4.

Beta 5 is planned for release in January. April 2001 is the target month for release of EnergyPlus 1.0.

DOE-2 Named in the Energy 100 Awards..

The DOE-2 program received one of the Energy 100 Awards. This award honors 100 of the best scientific and technological accomplishments sponsored by the U. S. Dept. of Energy during the past 30 years. These discoveries demonstrate DOE's commitment to save consumers money and improve the quality of life. Visit the Energy100 Awards website at

www.ma.doe.gov/energy100/list.html

New DOE-2 Consultant .....

We are pleased to add **The Deringer Group, Inc.** of Berkeley, California, to the list of DOE-2 consultants. **Joseph Deringer** and **Qiang (Peter) Zhang** are DOE-2 experts who offer years of building energy analysis experience. See the list of consultants.

www.DeringerGroup.com

What's Inside ?

Features

2 Web-Based Building Performance Assessment: The CBIP Screening Tool

22 Index to the *User News*, Vol 1 through Vol 21

Software

11 BLAST News

5 Building Design Advisor 2.0

8 DOE-2.1E

- 8 Help Desk, Training
- 8 DOE-2.1E Documentation Update
- 12 Directory of DOE-2 Software and Services
- 14 Pre- and Post-Processors for DOE-2
- 15 Special Versions of DOE-2
- 16 International DOE-2 Resource Centers
- 17 International DOE-2 Consultants
- 18 U.S. DOE-2 Consultants

7 ENERGY-10 1.3 (with WeatherMaker)

4 GenOpt 1.1

8 THERM 2.1

6 VisualSPARK 1.0

9 Software from Lawrence Berkeley Lab

Departments

7 Lighting Research Center

10 Meetings, Conferences, Symposia

Web-based DOE-2 Building Analysis for Canadian Users

Curt Hepting, DOE-2 consultant based in British Columbia, reports that Natural Resources Canada (NRCan) has put together a web site that ***performs live building energy analysis*** *to provide the user an estimate of the end-use energy requirements and costs for commercial buildings.*

Web-Based Building Performance Assessment: The CBIP Screening Tool

Curt Hepting and Diane Ehret
EnerSys Analytics, Inc.

Maria Mottillo
Natural Resources Canada

OVERVIEW

Natural Resources Canada (NRCan) has instituted a program to encourage energy-efficient design practices and to bring about lasting changes in attitudes and practices in the Canadian commercial building design and construction industry. The Commercial Building Incentive Program (CBIP) offers a financial incentive for incorporating energy efficient features into new commercial and institutional building designs. An eligible building design must demonstrate a reduction in energy use by at least 25 percent when compared to the requirements of Canada's Model National Energy Code for Buildings. The compliance process is very similar to ASHRAE's "Building Energy Cost Budget Method," following the reference building approach.

To help building owners and designers determine whether or not their building is a good candidate for the program, NRCan has developed a web-based building energy performance assessment tool. This tool quickly provides information about the building's anticipated energy use, energy costs, and emissions savings from implementing energy-efficient design options.

USING THE SCREENING TOOL

The screening tool is designed to rapidly provide feedback based on inputs for a select set of building characteristics. It allows users to enter values for their proposed design, limiting the inputs to the characteristics that affect energy use the most. Selected first are the building location, building type, and primary HVAC system type from over 2,500 possible combinations. Next, information is input about building characteristics. This includes the building envelope (insulation and window performance ratings), the mechanical system (focusing on elements that typically impact energy savings the most), lighting controls and density levels, and marginal utility rates. Each building characteristic input displays the corresponding "reference case" value for a similar building as if it were built to just meet the code (Fig. 1). This serves as a guideline and for quick comparison.

Mechanical System

	Reference Building	Your Design
Heating efficiency:	80.00%	80.00 %
Minimum outside air:	1.20	1.20 l/s/m²
Percent of floor area cooled:	38.00%	38.00 %
Cooling efficiency:	2.50	2.50 COP
Outdoor air economizer?	Yes	☑ Yes
Efficiency of exhaust air heat recovery:	0.00%	0.00 %
Service water heating fuel type:	Fossil	Fossil
Service water heating efficiency:	80.00%	80.00 %

Figure 1: Sample Inputs

CBIP provides almost instantaneous results, including:

- a clear indicator if the building design is likely to qualify for a CBIP incentive, and the estimated incentive amount;
- estimated percent energy savings, annual energy cost savings, and emissions savings as compared to the reference case;
- an end-use breakdown of the total energy consumption for both the proposed design and the reference case (Fig. 2); and
- a summary report of the inputs and results.

CBIP also allows users to return to the input screen, change the input values, and view the resulting differences between the current and previous iteration, as shown in Fig. 2. Thus, the screening tool serves as an educational device, that allows the user to investigate how various building characteristics impact energy use and costs.

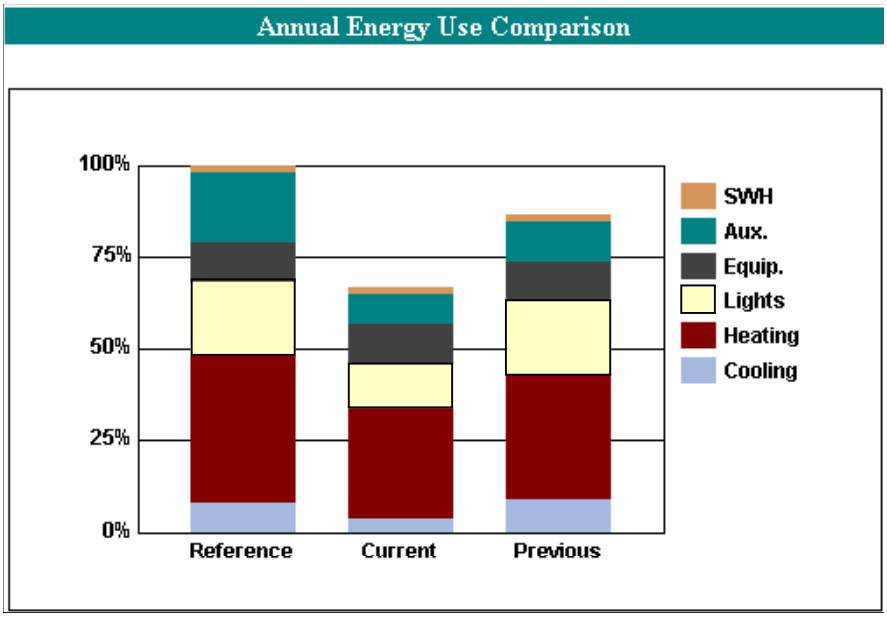


Figure 2: Sample End-Use Results Chart

THE CALCULATION ENGINE

CBIP includes a database of results from over 75,000 DOE-2.1E energy performance simulations. While the interface intentionally limits the number of input data, the background database system contains default values for approximately 80 different building characteristics. These characteristics represent a mix of "fixed" and "variable" parameters. The fixed parameters are non-changeable through the screening tool and are essentially used for setting up unique DOE-2 prototypes. The HVAC system type, for instance, is an example of a fixed parameter that defines a unique "prototype cell." Variable parameters can be changed instantly and are available through CBIP (see Fig. 1 for examples). Within CBIP, the variable parameters are assigned using standard design practice or prescribed energy code values, but can be assigned a full range of possible values as is appropriate.

CBIP's calculation methodology is based on engineering practices and thermodynamic principles, which are embodied in the hourly simulations. The calculation engine (DOE-2.1E) uses a unique process for rapidly accessing the results from a vast range of building energy simulations. More specifically, we make use of response factors derived from performing dozens of simulations on a specific prototype cell. Each simulation represents a discrete change to a building characteristic (lighting density, for instance). We then apply the appropriate functional relationships to a variable building characteristic based on how the change affects energy use by end-use. The results agree closely with actual DOE-2 simulations (Hepting et al, 1996) but take less than 1 percent of the time to calculate—an important factor for an Internet application.

This engineering-based "bottom-up approach" of using response factors allows for much more flexibility than econometric "top-down approaches." With statistically based econometric approaches there rarely, if ever, are enough building characteristics data available to make statistically valid correlations to monthly or hourly end-use energy by fuel type. Using CBIP's calculation approach, the user can change key building characteristics and can calibrate the model to known energy and demand requirements. Moreover, users

can modify any characteristic to immediately observe the impacts—as if a full building energy simulation had been run, but in a fraction of the time.

CONCLUSION

CBIP is currently in wide use, both by building professionals and by NRCan program administrators, to determine whether or not their building may qualify for an incentive before undergoing the time-consuming and relatively expensive task of building performance modeling. In addition, the tool provides valuable information about the key building characteristics that influence energy use. This can be valuable in helping establish conceptual design energy performance targets and the general means for how such targets can be met.

ACKNOWLEDGEMENTS

This article was adapted from *Web-Based Building Performance Assessment: First Steps with the CBIP Screening Tool*, published in the proceedings for the "Sustainable Buildings 2000" international conference held in Maastrict, The Netherlands, October 20–26, 2000 (http://www.novem.nl/SB2000).

REFERENCES

Hepting, C., G. Jung, and L. Herman. 1996. "Hourly End-Use Energy Analysis as a Value-Added Customer Service." *ACEEE 1996 Summer Study on Energy Efficiency in Buildings, Commercial Buildings: Program Design, Implementation, and Marketplace Issues*. American Council for an Energy Efficiency Economy: Washington, DC.

WEB REFERENCES

- Visit the screening tool http://nrn3.nrcan.gc.ca/cbipscreen/index.html
- Information about CBIP http://cbip.nrcan.gc.ca/cbip.htm

Curt Hepting, P.Eng., P.E.
EnerSys Analytics Inc.
2989 Delahaye Drive
Coquitlam, B.C. V3B 6Y9
Canada

Tel (604) 552-0700
Fax (604) 552-0713
enersys@infoserve.net
http://www.enersys.ca/info/

GenOpt® 1.1: Beta 2 Version

The Beta 2 version of GenOpt 1.1 has been released. It contains an additional algorithm for multi-dimensional optimization, new algorithms for one-dimensional optimization, and an algorithm for parametric runs in a multi-dimensional space. The new version also allows processing of multiple function values and has an improved graphical user interface.

GenOpt is a multi-parameter optimization program, available free of charge from LBNL. It automatically finds the values of user-selected design parameters that minimize an *objective function*, such as annual energy use, calculated by an external simulation program like EnergyPlus, SPARK, DOE-2, BLAST, TRACE, TRNSYS, etc. GenOpt can be used with any simulation program that has text-based input and output. It also offers an interface for adding custom optimization algorithms to its library.

Genopt 1.1, Beta 2 (with user manual) may be downloaded from

http://SimulationResearch.lbl.gov > GenOpt

Building Design Advisor 2.0

Decision making through the integrated use of multiple simulation tools and databases

The **Building Design Advisor** (**BDA)** is a Windows program that addresses the needs of building decision-makers from the initial, schematic phases of building design through the detailed specification of building components and systems. The BDA is built around an object-oriented representation of the building and its context, which is mapped onto the corresponding representations of multiple tools and databases. It then acts as a ***data manager*** and ***process controller***, automatically preparing input to simulation tools and integrating their output in ways that support multi-criterion decision making. The latest public release of BDA (version 2.0) is linked to three main applications:

- A **Schematic Graphic Editor (SGE)**, for graphic input of building components and systems,
- **DElight**, a simplified daylighting simulation tool, and
- the **DOE-2.1E** building energy simulation program.

The following **enhancements** have been made to BDA 2.0 (as of 09/15/00):

- Greater flexibility in project development with features such as "Save as.."
- Greater user control over object properties with editing of Solution and Story properties, building azimuth, etc.
- User interface enhancements allow easier navigation of the building model with less ambiguities.
- Several bug fixes.
- Extended documentation.

Current research and development efforts are focused on the development of links to:

- **Desktop Radiance**, a Windows 95/98/NT version of the **Radiance** lighting/daylighting simulation and rendering software, and
- **Athena**, a life-cycle analysis of embodied energy and environmental impact of materials.

The minimum and recommended system **requirements** to run the BDA software are as follows:

Minimum	**Recommended**
Pentium 75	Pentium 200 or better.
Windows 95, 98, NT 4.0.	Windows 95, 98, NT 4.0.
16 / 32MB RAM under Windows 95	24 / 64MB RAM under Windows NT 4.0.
30 MB of larger hard disk space.	60 MB of larger hard disk space.
640x480 or higher screen resolution.	1024x768 or higher screen resolution.

The BDA source code is available for licensing; if interested, please contact Dr. Papamichael at K_Papamichael@lbl.gov.

To learn more about the BDA software and to download a copy of the latest public version, please visit

http://kmp.lbl.gov/BDA

VisualSPARK

Release of Version 1.0

Available from Lawrence Berkeley National Laboratory,
VisualSPARK 1.0 allows you to build customized models of complex physical processes by connecting calculation objects. It is aimed at the simulation of innovative and/or complex building systems that are beyond the scope of programs like DOE-2 and EnergyPlus.

VisualSPARK Features:

- solves non-linear systems of arbitrary complexity
- solves from a few equations up to thousands of equations simultaneously
- user-specified time step
- robust solution methods
- HVAC component library
- easy to change variables from input to calculated
- dynamic plotting: plot results while simulation is running
- up to 20 times faster execution times than related programs (due to the use of graph-theoretic methods for problem partitioning and reduction in number of iteration variables)

The main elements of VisualSPARK are a **user interface**, a **network specification language**, a **solver** for solving simultaneous algebraic and differential equations, and a **results processor**. With the network specification language you link the calculation objects into networks that represent a building's envelope and/or HVAC system. The solver solves this network for user-specified input parameters. With the results processor you graphically display the results of the calculation.

VisualSPARK runs under the Windows 95/98/NT/2000, SunOS, Solaris, Linux and HPUNIX operating systems.

VisualSPARK costs $250. To purchase the program, go to
http://SimulationResearch.lbl.gov > VisualSPARK > Purchase

If you would like to get an idea of what the program does before purchasing it, you can review the SPARK User's Manual, which can be downloaded from http://SimulationResearch.lbl.gov > SPARK > SPARK User's Manual.

VisualSPARK was developed by the LBNL Simulation Research Group and Ayres Sowell Associates, with support from the U.S. Department of Energy, Drury Crawley, program manager

http://SimulationResearch.lbl.gov > SPARK

New DOE-2 Consultant .....

Marco Rapella **marco.rapella@libero.it**
Via Bonfadini 33
I-23100 Sondrio
ITALY

ENERGY-10, Version 1.3

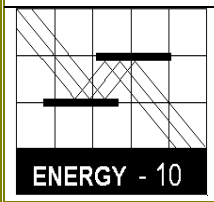
Version 1.3 of ENERGY-10 is now available. It includes the much-anticipated ***WeatherMaker*** function. *WeatherMaker* allows users to create their own weather files based on information available from nearly 4,000 weather stations throughout the U.S. Revisions to the program itself include some minor fixes, an improved and expanded Help section, and greater clarity in titling and identification of various sections. Contact the Sustainable Buildings Industries Council for more information, or to order your upgrade disc (the cost is $15, which covers production and shipping).

ENERGY-10, written in C^{++}, is a design tool for smaller residential or commercial buildings that are less than 10,000 ft^2 floor area, or buildings that can be treated as one- or two-zone increments. It performs whole-building energy analysis for 8760 hours/year, including dynamic thermal and daylighting calculations. ENERGY-10 was specifically designed to facilitate the evaluation of energy-efficient building features in the very early stages of the design process.

Input: Only four inputs required to generate two initial generic building descriptions. Virtually everything is defaulted but modifiable. As the design evolves, the user adjusts descriptions using fill-in menus (utility-rate schedules, construction details, materials).

Output: Summary table and 20 graphical outputs available, generally comparing current design with base case. Detailed tabular results also available.

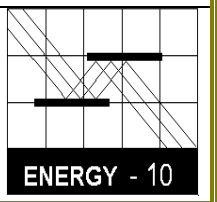
Platform: PC-compatible, Windows 3.1/95/98, Pentium processor with 16 MB of RAM is recommended.



Sustainable Buildings Industries Council

Douglas K. Schroeder
Associate Director
1331 H Street, NW, suite 1000
Washington, D.C. 20004 USA

Tel: (202) 628-7400 ext 210
Fax: (202) 393-5043
SBICouncil@sbicouncil.org
www.psic.org/energy10.htm



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Lighting Design Lab

Bright Ideas from the Pacific Northwest

The mission of the Lighting Design Laboratory is to transform the Northwest lighting market by promoting quality design and energy-efficient technologies. To that end, LDL offers classes on all aspects of energy-efficient lighting, demonstrations of new technologies, a Daylighting Laboratory, a 1200-ft^2 mock-up facility, and a full reference library. Advice and consultations from lighting experts is also available.

www.lightingdesignlab.com

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The Building Energy Simulation User News is published bi-monthly and distributed electronically by the Simulation Research Group at Lawrence Berkeley National Laboratory, with cooperation from the Building Systems Laboratory at the University of Illinois. Direct comments or submissions to Kathy Ellington, MS: 90-3147, Lawrence Berkeley National Laboratory, Berkeley, CA 94720, or email KLEllington@lbl.gov or fax us at (510) 486-4089. Direct BLAST-related inquiries to the Building Systems Laboratory, email support@blast.bso.uiuc.edu or phone (217) 333-3977 This work was supported by the Assistant Secretary for Energy Efficiency and Renewable Energy, Office of Building Technology, State and Community Programs, Office of Building Systems of the U.S. Dept. of Energy, under Contract No. DE-AC03-76SF00098

DOE-2 DOE-2 DOE-2

PC Version of DOE-2.1E from ESTSC

DOE-2.1E (version 107) for Windows is available from the Energy Science and Technology Software Center (ESTSC). Previously, ESTSC licensed only UNIX and VAX versions. This updated version of DOE-2 incorporates bug fixes and new features such as a Cooled Beam HVAC system and polygon input for walls, floors and ceilings. Like previous DOE-2.1E products from ESTSC, this version accepts textual BDL input but does not have a graphical user interface. Cost of DOE-2.1E-WIN (Version 107) is:

$ 300 U.S. Government, non-profit Educational
$ 575 U.S., Mexico, Canada
$ 1075 Other Foreign

To order, call Ed Kidd or Walt Kelly at ESTSC (865) 576-2606, or email to estsc@adonis.osti.gov.

DOE-2.1E Documentation Update

Corrections to Appendix A (Hourly Report Variables) of the DOE-2.1E *Supplement* may be downloaded from the SRG web site (http://SimulationResearch. lbl.gov). Click on "Documentation" under DOE-2 in the left menu. You want "Update Package #3."

DOE-2 Help Desk

Bruce Birdsall - Phone/Fax: (925) 671-6942, M-F 10 a.m. to 3 p.m. PDT.
Contact Bruce if you have a DOE-2 problem or question. If you need to send a fax, please be sure to phone him first. This is a free service, supported by the U. S. Department of Energy.

DOE-2 Training

DOE-2 courses for beginning and advanced users: phone Marlin Addison at (602) 968-2040, or send email to marlin.addison@doe2.com

DOE-2 DOE-2 DOE-2

THERM 2.1

Two-Dimensional Building Heat Transfer Modeling

THERM is windows-based software for modeling heat-transfer effects in building components such as windows, walls, foundations, roofs, doors, appliances, and other products where thermal bridges are of concern. The program's two-dimensional heat-transfer analysis, based on the finite-element method, allows you to evaluate a product's energy efficiency and local temperature patterns, which may relate directly to problems with condensation, moisture damage, and structural integrity.

THERM is available free of charge from the Building Technology Department at Lawrence Berkeley National Laboratory. Download from

http://windows.lbl.gov/software/therm/therm_getacopy.htm

Software Available From Lawrence Berkeley National Laboratory

Downloads	
BDA 2.0 (Building Design Advisor)	kmp.lbl.gov/BDA
COMIS (multi-zone air flow and contaminant transport model)	www-epb.lbl.gov/comis
EnergyPlus™ (new-generation whole-building energy analysis program, combining best features of BLAST and DOE-2)	To beta test EnergyPlus go to SimulationResearch.lbl.gov > EnergyPlus
GenOpt®**1.1** (generic optimization program)	SimulationResearch.lbl.gov > GenOpt
RADIANCE (analysis and visualization of lighting in design)	radsite.lbl.gov/radiance/
Desktop Radiance (integrates the Radiance Synthetic Imaging System with AutoCAD Release 14)	radsite.lbl.gov/deskrad/
RESEM (Retrofit Energy Savings Estimation Model) (calculates long-term energy savings directly from actual utility data)	eetd.lbl.gov/btp/resem.htm
SUPERLITE (calculate illuminance distribution for room geometries)	eetd.lbl.gov/btp/superlite20.html
THERM 2.1 (model two-dimensional heat-transfer effects in building components where thermal bridges are of concern)	windows.lbl.gov/software/therm/therm.html
WINDOW 4.1 (thermal analysis of window products)	windows.lbl.gov/software/window/window.html

Request by Fax from 510.486.4089	
RESFEN 3.1 (choose energy-efficient, cost-effective windows for a given residential application)	windows.lbl.gov/software/resfen/resfen.html

Web Based	
Home Energy Saver (quickly compute home energy use)	hes.lbl.gov

Purchase	
SPARK (Simulation Problem Analysis and Research Kernel) (build simulations of innovative building envelope and HVAC systems by connecting component models)	For Windows, SUN, Linux, go to SimulationResearch.lbl.gov > SPARK
ADELINE 2.0 (day/lighting performance in complex spaces)	radsite.lbl.gov/adeline/

Meetings, Conferences, Symposia

FEMP
Energy 2001 Workshop

To be held
June 4-6,2001 in Kansas City, MO
Contact: Rick Klimkos (FEMP)
Tel: 202.586.8287
fax: 202.586.3000
Net: http://www.energy2001.ee.doe.gov

CLIMA 2001

To be held
September 15-18, 2001 in Naples, Italy
Contact the secretariat at
Tel: +39.02.55.193.446
Email: clima@clima2000.it
Net: http://www.clima2000.it

9th National Conference on Building Commissioning

To be held
May 9-11, 2001, in Cherry Hills, NJ
Contact: Carolyn Dasher, Conference Manager
Tel: 503.248.4636 x 204

Fax: 503.295.0820
Email: cdasher@peci.org
Net: http://www.peci.org/ncbc

ASHRAE

ASHRAE Winter Meeting
To be held
January 27-31 in Atlanta, GA

ASHRAE Annual Meeting
To be held
June 23-27, 2001 in Cincinnati, OH

Contact: jyoung@ashrae.org
ASHRAE Meetings Section
1791 Tullie Circle NE
Atlanta, GA 30329
Tel: 404.636.8400 -- Fax: 321.5478
Net: http://www.ashrae.org

I B P S A

BUILDING SIMULATION 2001

To be held
August 13-15, 2001 in Rio de Janeiro, Brazil
All information may be found at the BS2001 web site:
WWW.LABEEE.UFSC.BR/BS2001/

BLAST*news*

www.bso.uiuc.edu

Building Systems Laboratory (BSL)
30 Mechanical Engineering Building
University of Illinois
1206 West Green Street
Urbana, IL 61801
Telephone: (217) 333-3977
Fax: (217) 244-6534
support@blast.bso.uiuc.edu

The **Building Loads Analysis and System Thermodynamics (BLAST** program predicts energy consumption, energy system performance and cost for new or existing (pre-retrofit) buildings.

BLAST contains three major sub-programs:

- **Space Load Prediction** computes hourly space loads in a building based on weather data and user inputs detailing the building construction and operation.
- **Air Distribution System Simulation** uses the computed space loads, weather data, and user inputs.
- **Central Plant Simulation** computes monthly and annual fuel and electrical power consumption.

Heat Balance Loads Calculator (HBLC)
The BLAST graphical interface (HBLC) is a Windows-based interactive program for producing BLAST input files. You can download a demo version of HBLC (for MS Windows) from the BLAST web site (User manual included).

HBLC/BLAST Training Courses
Experience with the HBLC and the BLAST family of programs has shown that new users can benefit from a session of structured training with the software. The Building Systems Laboratory offers such training courses on an as needed basis typically at our offices in Urbana, Illinois.

WINLCCID 98
LCCID (Life Cycle Cost in Design) was developed to perform Life Cycle Cost Analyses (LCCA) for the Department of Defense and their contractors.

To order BLAST-related products, contact the Building Systems Laboratory at the address above.

Program Name	Order Number	Price
PC BLAST Includes: BLAST, HBLC, BTEXT, WIFE, CHILLER, Report Writer, Report Writer File Generator, Comfort Report program, Weather File Reporting Program, Control Profile Macros for Lotus or Symphony, and the Design Week Program. The package is on a single CD-ROM and includes soft copies of the BLAST Manual, 65 technical articles and theses related to BLAST, nearly 400 processed weather files with a browsing engine, and complete source code for BLAST, HBLC, etc. Requires an IBM PC 486/Pentium II or compatible running MS Windows 95/98/NT.	3B486E3-0898	$1500
PC BLAST Package Upgrade from level 295+	4B486E3-0898	$450
WINLCCID 98: executable version for 386/486/Pentium	3LCC3-0898	$295
WINLCCID 98: update from WINLCCID 97	4LCC3-0898	$195

The last four digits of the catalog number indicate the month and year the item was released or published. This will enable you to see if you have the most recent version. All software will be shipped on 3.5" high density floppy disks unless noted otherwise.